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Market Situation

In April, 1999, the three largest US corn processors, Cargill, Archer-Daniels-Midland, and AE Staley announced that they would not accept corn from hybrids that had genetic modifications not yet approved for sale in the European Union (EU) (www.grainnet.com/BreakingNews/articles.html?ID=3581). While the USA sells little whole corn to Europe, it does export corn gluten products to the EU. Gluten feed and meal are produced from the protein and bran fractions of corn after starch has been extracted in a wet mill plant. This statement affected an estimated 3-7% of the corn about to be planted this spring, but nonetheless greatly increased the awareness of the US market to the rapidly expanding genetically modified organism (GMO) issue in Europe. Consumer pressures increased through the growing season to the point that, in September, ADM requested that elevators serving its plants separate all GMO products from all non-GMO products, regardless of EU approval status. (www.grainnet.com/BreakingNews/articles.html?ID=4653)

A GMO is a living organism that has had some characteristic improved by genetic engineering, the recently developed capability to insert genes from one species to another. Genetic modifications are referred to as events. A particular seed (or plant) either has an event or it does not. The current GMO corn and soybeans feature enhanced agronomic traits, either insect or herbicide resistance. These products have been rapidly accepted by producers; an estimated 45-55% of the 1999 soybean crop, and 30-40% of the 1999 corn crop originated from genetically modified seed (Taylor, www.house.gov/science/taylor_101999.htm). However, these traits do not provide any direct, visible benefit to consumers except in the form of consistent supply, which is hard to value.

All GMO events are approved in the USA by each of three government agencies, United States Department of Agriculture (USDA) (for general food quality and worker safety), Environmental Protection Agency (EPA) (for environmental impact), and Food and Drug Administration (FDA)(for toxicity). The concept of substantial equivalence (to the product replaced) is used to evaluate GMO products and great reliance is made on agency technical review of industry data (Babcock et al. 1999).

The EU has a more complex approval process, based on two regulatory actions and requiring approval (by failure to object) of member nations using whatever criteria, the nations wish to use. Additionally member nations may on their own prohibit distribution of an approved GMO, as is being done in Switzerland and Luxembourg. The most recent action (Regulation 258/97/EC, 1997) requires labeling of any food produced from GMO input. New approvals are not expected

for some time. (Mochini and Corrigan, 1999). Political pressures tracing back to the 1996 "mad cow disease" outbreak and more recently the dioxin contamination in Belgium (neither of which have any relationship to GMO crops) have sensitized regulators to all food supply questions.

The Japanese Ministry of Agriculture, Food and Forestry (MAFF) approvals are generally the same as those of the EU. However, in October 1999, MAFF announced that mandatory labeling of 27 soy and corn food products (direct human consumption) would be required beginning April 2001. (Statement of the Japanese Delegation for the 1999 IAFPA Meeting, 1999). The Japanese action was very specific in limiting labeling requirements to those human food products "in which modified DNA or protein produced therefrom is remaining". This eliminated oils, syrups and heat-processed products from labeling. Animal feed products were not included. An October 31, 1999 survey by Dow Jones indicated that 65% of Japanese food processors are planning to switch to non-GMO grains, with an expected 20% increase in procurement costs to be passed on to consumers (Nikkei (Dow Jones), 1999). Reuters reported on November 2, 1999 that Tokyo premiums for non-GMO corn and soybeans have increased dramatically, to 40-60 cents per bushel (Reuters, 1999).

US consumers appear to have somewhat conflicting viewpoints. Several surveys and focus group sessions have indicated that over 70% of US consumers believe that genetically engineered foods are safe, even after the publicity from the EU. Yet the same work and other less controlled public opinion polls show a large percentage favoring labeling.

Against this backdrop of apparently increasing demand for non-GMO grains, producers and grain handlers are searching for methods to assure customer preferences within the practicality of high volume operations. Despite the discussion and publicity, little segregation occurred during harvest 1999, except for prearranged programs that were already in operation. Two elevator surveys taken during harvest indicated only 8-11% of elevators were either segregating or requesting certification of GMO grains delivered by producers (www.grainnet.com/ArticleLibrary/BreakingNews/articles.html?id=5109 and www.grainnet.com/ArticleLibrary/BreakingNews/articles.html?ID=4836). Until consistent premiums are available marketwide, this situation is not likely to change.

GMO Analysis

There are presently three methods for GMO analysis. Two are chemical methods; one (Polymerase Chain Reaction) measures DNA fragments directly, the other (immunoassay or ELISA) measures proteins created in conjunction with the genetic modification. The third, herbicide bioassay, involves treating germinated seeds with herbicide. GMO seeds (for that herbicide) will survive; others will die.

The PCR method is considered the most sensitive GMO detection method with claimed sensitivity to 0.1%. The test takes 2-3 days at a cost of $200-$400 per sample. PCR is the reference method for the EU.

The ELISA method uses a selective antibody to bind with specific proteins associated with a particular modification. The binding process also causes a color change that can either be read for intensity (to measure levels of GMO) or, in the shorter test strip method, just a yes/no indication for a preset threshold level. Intended for on site use, the test strips require about 5-15 minutes and cost around $6/sample.

Both methods have limitations, in addition to the time required. In either case, a small amount of grain is actually extracted to produce the test solution, around 10-20 grams, which is about 30-60 seeds. Sampling and sample handling is critical. The sampling errors are similar to those for mycotoxins, which means at least 5- and preferably 10-lb samples taken from multiple locations within the load should be ground, mixed, then divided for the analysis portion. Subdivision of whole grain samples will not produce accurate results. There will be a high probability of false negative readings (no indication, but GMO actually present) in samples that are at or near the tolerance level, with occasional very high readings. The chance of an accurate sample is actually small.

This can be illustrated with an example. Suppose we have a 10-lb sample that is truly a 1% GMO blend. There are about 13,000 seeds in this sample, of which 130 would be GMO seeds. To get down to a 60-seed sample would take 8 half-and-half divisions, with 256 possible 60-seed subsamples. Clearly not all of the subsamples can possibly have the right number of GMO seeds. Even at a 5% level, there are not enough GMO seeds to give each possible subdivision the three, that would be required to test 5%. Division of ground samples is the only way around this problem.

In reality there is no practical way to test inbound grain at a country elevator where time and skills are both limiting. Pretesting samples from producer bins or deferring analysis to a point where more time is available are means of dealing with this situation. In the latter case, producer statement is the only identification method at first point of sale, and the burden of proof (and correction if there is a problem) falls on the subsequent handlers or the user. Grain Journal (Roseboro, 1999) has published an extensive list of third party labs and suppliers for GMO testing.

Handling Considerations

Given low tolerance levels, mixing errors will be a major problem. Even with current specialty grains, the grain market is not accustomed to preserving absolute purity, especially between lots that ostensibly look the same. Control points begin well before harvest and extend to the final user.

- Purity of original seed. Most seed plants handle GMO and non-GMO seeds.
- Planting system cleanout
- Cross pollination. Mostly a corn issue.
- Combine cleanout Tank, cleaning shoe, returns cylinder, clean grain system
- Wagons, handling systems

- Storage bins
- Elevator handling systems, pits, legs.
- Railcars or barges. 10-50 bushels often remain
- Accidental mixing. One truck in error could contaminate 80,000 bushels.
- Export elevator handling
- Ship hold
- Cleanup operations

Each of these has the potential to contribute to overall errors, and to the chances of poor samples. A very disciplined effort will be needed to manage high volume handling systems to deliver specialty products. It is doubtful that non-GMO grains will generate premiums enough to justify full Identity Preserved containerized or bagged shipments, so we will have to adapt the bulk handling system as best we can.

Conclusion

The GMO issue has been a clear signal that consumer preferences, documentation, and traceability will increasingly dominate grain markets. There will probably be a segment of the market that will want to pay for non-GMO products, but the real long-term challenges will arise as a wide array of new high-value specialty crops enters the market. Most of these will carry traits that are easily recognized by consumers as beneficial, and so will diminish the GMO debate in its present form. However, the US production and marketing network will have to adapt quickly to being, at least in part, a raw material supply chain rather than being just a commodity distribution sector.

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